

## Normal Spectral Emittance of Alumina Up to the Melting Point: Measurement Versus Modeling

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Both polarizations of the normal spectral emittance of a single-crystal of alumina ( $\text{Al}_2\text{O}_3$ ) were measured over a large frequency range ( $100\text{-}16\,000\text{ cm}^{-1}$ ,  $100\text{-}0.625\text{ }\mu\text{m}$ ) and from room temperature up to the liquid state. With increasing temperature, the emittance exhibits an unexpected behavior in the transparency region. The compound starts to absorb in the mid, near infrared and visible ranges 100 degrees below the expected melting point at 2327 K. The changes also affect dramatically the phonon region within the same temperature range. In order to understand the microscopic origin of this behavior a semi-quantum dielectric function model, involving a Debye relaxation term, was used to fit the experimental data in the whole spectral range. Within the phonon range the fit reveals a major change that takes place far below the melting point. The parameters of the Debye term impacting the transparency region are characteristic of a temperature-induced mobility due to hopping of electrons related to changes in interatomic bonding. The study of this measured thermophysical property does open an interesting discussion about the crystallographic structure, the melting temperature of pure single crystals of alumina and the existence of premelting effects.